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In the United States Patent and Trademark Office

Board of Patent Appeals and Interferences

Scott E. Johnston, Applicant Pro Se, Appellant

Appeal From Final Rejection of

James F. Hook, USPTO / GAU 3752, Primary Examiner

Appn. Number: 09/312,992

APPELLANTS' BRIEF

AMENDED - SUPERSEDES PREVIOUS BRIEF

REAL PARTY IN INTEREST

The real party interest is listed above (Scott E. Johnston).

RELATED APPEALS AND INTERFERENCES

Not Applicable

STATUS OF CLAIMS

Claims 1-9 are pending in the application. Claims 1-9 are rejected.

This is an appeal from the final rejection of claims 1-9, all the claims in the application.

STATUS OF AMENDMENTS

Not Applicable - No amendments have been filed subsequent to final rejection.

SUMMARY OF INVENTION

A large diameter spirally formed pipe, having a diameter larger than similar pipe produced in the past. This pipe is round or may be reshaped into an arch shape. As a round pipe the invention includes spirally formed pipes above 15 feet in diameter, and as a round pipe reshaped into an arch shape, the invention includes, spirally formed pipes above 144 inches in diameter before being reshaped into an arch shape. This large diameter spirally formed pipe allows for the manufacture of products that have been traditionally produced by other means.
(Appellant's Abstract of the Disclosure)

FIG. 2 of the appellant's drawings provides a schematic representation of the pipe generally designated 10. Page 3 of the specification lines 16-27 provides details of construction as follows: The pipe is composed of an elongated strip of ductile material, such as galvanized steel, which is formed into adjacent, helical convolutions. As illustrated, convolutions 14 are joined at 12. Convolutions 14 form the wall of the pipe which may be smooth, corrugated or profiled. Section view FIG. 5. illustrates the variety of pipe wall styles. The smooth wall 16 is joined by a welded seam 15, the corrugated wall 18 is joined by a conventional double lock seam 17, and the profiled wall 22 is joined by a conventional double lock seam 21. As the pipe diameter is increased, the thickness of material and size of corrugation or profile is typically also increased. So then, in most cases the dimensional proportions of the smooth, corrugated and profiled wall increases as pipe size is increased, although if desired can be held to a smaller size for some applications.

The pipe 10 may be round as shown in FIG. 3, or reshaped into an arch shape as shown in FIG. 4. A pipe according to the invention is larger than 15 feet in diameter when left in the round shape, and a pipe according to the invention is larger than 144 inches in diameter if it is then reshaped into an arch shape.

Page 1 and 2 of the specification provides background for the invention. The fact that large diameter pipe and arch shapes have been produced from bolted or welded together sections of material is discussed. That these products require a crew of skilled workers, a large lifting device, and considerable time to assemble.

Under the detailed description of the invention on Pages 2 and 3 many of the new uses for spirally formed pipe are discussed. Referring to FIG. 1, highway overpasses 52, barns or storage buildings 37, homes 45, grain silos 32, water tanks 61 are shown along with traditional uses such as storm drain 21, and pile pipe or shell 67. It is stated on page 3 lines 12-15, Traditional uses such as highway storm drain 21 and pile pipe or shell 67 are well known uses for spirally formed pipe, while overpasses 52, storage buildings 37, homes 45, silos 32 and water tanks 61 being larger in diameter, have generally been produced from formed metal panels with bolted or welded construction.

Page 2 lines 9-15 disclose that the appellant has developed new machinery for producing "Large Diameter Spirally Formed Pipes", and Large Diameter Arching Machinery" capable of producing Large Arches. The Portable Spiral Pipe Machinery and the Arching Machinery are both now patented, (U.S. Patent No. 6,000,261 and 6,260,403). This illustrates that invention was required to produce the claimed "Large Diameter Spirally Formed Pipe".

ISSUES

1.) Whether claims 1-9 are unpatentable under 35 U.S.C. § 102(b) over "The Handbook of Steel Drainage and Construction Products".

2.) Whether claims 1-4 are unpatentable under 35 U.S.C. § 102(b) or in the alternative 35 U.S.C. § 103(a) over "Holcomb".

3.) Whether claims 5-9 are unpatentable under 35 U.S.C. § 103(a) over "Holcomb" in view of "The Handbook of Steel Drainage and Construction Products".

GROUPING OF CLAIMS

The appellant is concerned that the selection of a claim to represent a group of claims be applied to independent (base claims) claims only. Since the examiner has rejected claims 1-9 under 35 U.S.C. § 102(b) it seems that claims 1, 5, and 9 should be reviewed to determine if, in fact, the invention as claimed is actually anticipated in every form claimed. For the rejections of claims 1-4 under 35 U.S.C. § 102(b) or in the alternative, 35 U.S.C. § 103, claim 1 should be relied upon, and for the rejection of claims 5-9 under 35 U.S.C. § 103, claim 5 should be relied upon, however claim 9 should also be reviewed to determine if the rejections should apply to it as well. These base claims potentially identify significant variations of the claimed invention that could be used to distinguish the invention from the prior art.

ARGUMENT REGARDING ISSUE 1.

Whether claims 1-9 are unpatentable under 35 U.S.C. § 102(b) over "The Handbook of Steel Drainage and Construction Products".

1.) What does The Handbook of Steel Drainage actually teach? Those skilled in the art recognize that spirally formed pipe is "shop fabricated", meaning, that it is made at a factory, then shipped to the job site. The following paragraph is taken directly from the reference of the Handbook of Steel Drainage (pg. 39, 2nd paragraph):

"Corrugated metal pipe was first developed and used for culverts in 1896. As experience was gained in the use of this thin-wall, lightweight, *shop-fabricated* pipe, the diameters gradually increased to 96 in. and larger. Fill heights became greater, even exceeding 100 ft. A further development, in 1931, was structural plate pipe with larger corrugations, for *field assembly*. Diameters and arch spans beyond 25 ft. have been successfully installed."

The chart on page 38 does not mention spirally formed pipe, or the reshaping of pipe. It does, however refer to "plates", in all of the examples. The larger sized pipe products, referred to, within the reference are made from "structural plates" which are shipped to location and **"bolted together"**. All of the illustrations, charts, photographs, and text support this position. Page 40 of the Handbook of Steel Drainage, discusses corrugation profiles for various pipes and refers to spirally formed pipe as lock seam pipe; it states: "For lock seam pipe, the seams and corrugations run helically (or spirally) around the pipe. For small diameters of sub drainage pipe (6, 8, 10 in., etc.) the pitch vs. depth dimension is 1 ½ x ¼ in. Larger sizes (with diameters to 120 in.) use 2 x ½ in., 2 2/3 x ½ in. and 3 x 1 in. corrugations."

It can be seen from the quoted paragraphs that the examiner's position is not supported by the reference. A review of the reference reveals that there is no mention of a spirally formed pipe that would meet the claims. The reference can not be utilized as an anticipation.

2.) It is extremely important to note from the onset that the examiner did not rely on content found in the reference to support his rejection, but rather fabricated or distorted the teachings of the reference. Referring to the Handbook of Steel Drainage, the examiner's final office action (pg 2, item 2) implies that there is language referring to spirally formed pipes, as conventional pipes, and that "it is noted that conventional pipes of this type are capable of ranging in diameters from 6 inches to 21 feet in diameter". This language does not exist within the reference sited (expressed or implied). On what page can the notation be found? What does the note actually say? On what page can one find mention of conventional pipes? If the statement is a paraphrase, or summary, there should be some text within the reference to provide the alleged facts asserted. Can a statement that is not supported within the reference be used to identify an anticipation?

3.) Rather than provide information about this alleged notation, the examiners' *"Response to Arguments"* on page 4 item 6 of the final office action discusses the teachings of the Handbook of Steel Drainage, regarding "steel conduits". Apparently not recognizing that the term "steel conduits" is a generic term referring to a wide range of products, it does not identify spirally formed pipe, any more or less than it can be utilized to identify the "Median and shoulder spillway drain" as seen in on page 22, Fig. C-1. The examiner then goes on to provide teachings regarding

the table on page 38 and the alleged description on page 40, that is so appalling, as to render one speechless. The examiner proclaims, and I quote; "Further the table on page 38, and the description on page 40 state that pipes can be formed in round shapes up to 21 feet in diameter, and 20 feet 7 inches for arched conduits, where page 40 sets forth that this is true of lock seamed corrugated tubing." Page 40 provides no mention of the large round shapes and arched conduits illustrated on page 38, and more importantly the only diameters mentioned are 6, 8, and 10 inch and also diameters to 120 inch. There is no mention of arched pipe of any size. Is this type of conjecture, and or fabrication acceptable?

4.) The final office action goes on to say (page 4 and 5), "With respect to the argument of hindsight for the Steel Drainage reference, such is not persuasive in that hindsight reasoning can only be applied to cases of obviousness, which refers only to rejections under 35 U.S.C. § 103(a)" The examiner then quotes form paragraph 7.37.03 from the MPEP. This is contradictory. Is the examiner suggesting that of necessity some degree of hindsight reasoning has been applied? If this is the case how can this reference be utilized under 35 U.S.C. § 102.?

5.) On page 5 line 10 The examiner states "a change in diameter is not a patentable feature." This, likely is the reason the examiner is attempting to defeat this application. Generally it's true, and well supported that merely following in the steps of prior teachings and increasing or decreasing the size of an article is not the result of invention. In fact, in most cases it is simply an issue of obviousness. In re Rose, 220 F.2d 459, 105 USPQ 237 (CCPA 1955) is a perfect

example, anyone utilizing the teachings of one of the many prior art references could have simply added a few more pieces of lumber and created an infringing stack of lumber. This is not at all the case with Spirally Formed Pipe. To produce a pipe as the appellant has claimed requires invention. Thomas Edison was awarded patent protection for his light bulb, but U.S. Electric Lighting Co., began to copy Edison, asserting that a prior French patent disclosed the Edison invention with the exception of using carbon for the filament. Edison claimed that the filament as claimed was not naturally occurring, that it required invention to produce. "It involves invention to reduce the size of a carbon element to a filament form in an electric lamp." Edison Electric Light Co. v. U.S. Electric Lighting Co., 52 Fed. Rep. 300.

6.) Page 5 lines 11-15 of the examiners final office action states "it is immaterial what apparatus is used or what method is used to make the article when claiming an article." The examiner has missed the fact that it requires invention to produce the Large Diameter Spirally Formed Pipe products as claimed. This speaks directly to why the references did not anticipate or render obvious the appellants' invention. It is not immaterial, the method used to make the article, it is, in fact, of the essence.

7.) Next, the examiner asserts "It is also not pertinent to argue the method in which the article is supplied to the work site, such is essentially the same as any other method claim in an article claim, it holds no patentable weight" (page 5 line 16 of the final office action). The appellant did not argue which method could be utilized to supply the article to the work site, but rather that the

article as claimed could not be supplied to the work site by those skilled in the art of the references. The point being, the references do not anticipate, or render obvious the appellants' invention because they do not address or resolve the issue how to supply this large pipe product to the work site. This again speaks to the fact that it requires invention to produce the Large Diameter Spirally Formed Pipe products as claimed.

8.) The examiner then states (page 5 line 19) "The various uses for the article disclosed in the arguments is also immaterial when such is not being claimed". The examiner has missed the fact that these arguments generally were presented to illustrate that the claimed invention provides for unexpected results, unappreciated advantages, solves unrecognized problems and so on.

Where has the examiner addressed these arguments? Please note, that arguments have been presented that the claimed invention provides for unappreciated advantages over The Handbook of Steel Drainage and these arguments as yet, have not been answered. *In re Herrmann, 261 F.2d 598, 120 USPQ 182 (CCPA 1958)* the court noted that since the applicant's statement of advantages was not questioned by the examiner or the Board of Appeals, it was constrained to accept the statement on face value and therefore found certain claims to be allowable. See also In re Soni, 54 F.3d 746, 751, 34 USPQ2d 1684, 1688 (Fed Cir. 1995).

9.) Next, the examiner addresses the argument that the Steel Drainage reference teaches of other forms of pipe in addition to spirally formed pipe and states (page 6 line 4) "even though the

reference teaches other embodiments it does not prevent it from disclosing the embodiment claimed by the applicant". This response provides no information to support the examiners' position, it is simply a statement of possibility. Where has the examiner found the "embodiment claimed by applicant"? Is the examiner suggesting that it's acceptable to combine embodiments of one product with embodiments of another product within the reference to argue an anticipation under 35 U.S.C. § 102(b)?

10.) Under the section in the MPEP, Distinction Between 35 U.S.C. § 102 and § 103, it states that "The distinction between rejections based on 35 U.S.C. § 102 and those based on 35 U.S.C. § 103 should be kept in mind. Under the former (35 U.S.C. § 102) the claim is anticipated by the reference. No question of obviousness is present. In other words, for anticipation under 35 U.S.C. § 102, the reference must teach every aspect of the claimed invention either explicitly or impliedly. Any feature not directly taught must be inherently present."

11.) The Handbook of Steel Drainage does not disclose each and every element of the claimed invention. It is therefore apparent that the examiner's anticipation rejection raise the question of inherency with respect to the reference structures. Inherency may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient. The examiner must provide some evidence or scientific reasoning to establish the reasonableness of the examiner's belief that the functional limitation is an inherent characteristic of the prior art. In re Oelrich, 666 F.2d 578, 581, 212 USPQ 323, 326 (CCPA

1981) and In re Swinehart, 439 F.2d 210, 213, 169 USPQ 226, 229 (CCPA 1971). The examiner has provided no such evidence or reasoning with regard to this reference. It is also apparent from a thorough review of the reference that any such evidence or reasoning the examiner might put forth, will of necessity be somehow contorted, or abstract. With this in mind, these arguments, if any, should be considered in light of the following:

A reference so obscure in its terminology that two conflicting theories as to its meaning may be deduced therefrom and supported by equally plausible arguments is too indefinite to be utilized as an anticipation. (see Cimiotti Unhairing Co. et. al v. Comstock Unhairing Co. et. al., 115 Fed. Rep. 524.)

12.) There is nothing in this reference that would enable one skilled in the art to produce spiral pipe at the jobsite. Furthermore, absent the ability to produce the pipe at the jobsite, there is nothing in the reference that would enable one skilled in the art to convey such a large pipe to location, or for that matter to explain the necessary modifications required for the factory machinery to produce larger sizes of pipe, i.e., tooling, pipe support modifications, etc. To reshape a spirally formed round pipe into an arch shape requires a substantial piece of equipment. There is nothing in the reference that would enable one skilled in the art to produce and or reshape a spirally formed pipe of any size.

§ 119. Sufficiency of description (60 Am Jur 2d.)

In order for a prior art printed publication to anticipate an invention, the description thereof must disclose the complete and operative invention in such full, clear, and exact terms as to enable any person skilled in the art to which it pertains to practice the invention to the same extent as he would have been enabled to do so if the information were derived from a prior patent. In short, a printed publication is to be tested by the same rules as those applicable to a prior printed patent.

An article does not anticipate an invention under 35 U.S.C. § 102(a) if it is not so particular and definite that one versed in the art could gain possession of the claimed subject matter without undue experimentation. In re Sheppard, 52 CCPA 859, 339 F2d 238, 144 USPQ 42.

The examiner must go beyond merely presenting a theory, to support inherency. It must be demonstrated that one of ordinary skill in the art would be enabled to make the claimed invention.

D.Del. 1990. Even if a prior printed publication discloses the claimed invention, it will not suffice as prior art if it was not enabling; therefore, defendant must show that each element of claim in issue is found in the prior patent or publication, either expressly or under the principles of inherency and that one of ordinary skill in the art could have combined the publication's description of invention with his own knowledge to make the claimed invention. 35 U.S.C. § 102(b). General Elec. Co. v. Hoechst Celanese Corp., 740 F.Supp. 305.

D.Del. 1989. Any degree of physical difference between inventions, however slight, invalidates claims of anticipation in a patent infringement action. E.I. du Pont de Nemours & Co. v. Polaroid Graphics Imaging, Inc., 706 F.Supp. 1135, affirmed 887 F.2d 1095, rehearing denied.

13.) The appellants' FIG. 1 provides illustrations for various products not found in the references. With the appellants' new Large Diameter Spirally Formed Pipe invention it is now possible to produce pipes with much larger corrugations, without the limitations of a bolted structure. Just one example of the incredible possibilities is Highway Overpasses. The pipes required can be made in a day, a completed overpass could be produced in a few weeks. A concrete or traditional steel bridge design, requires months to build, are potentially more environmentally disruptive, particularly when they have exceeded their useful life. Spirally Formed Pipes are completely recyclable as scrap metal. There are other advantages as well, and of course many other uses. The bolted together pipe products shown in The Handbook of Steel Drainage, do not function the same way as the appellants' invention , they do not produce the same results. "It's a New World" when it comes to steel pipe products, Large Diameter Spirally Formed Pipes are about to revolutionize several industries. Bridges, homes, shelters, and so on, made faster, providing greater safety and value than competitive products.

CI.Ct. 1986. Anticipation or lack of novelty under patent law is established only when single prior art reference expressly describes or inherently contains each element of claimed invention, functioning in substantially the same way to produce substantially the same result. 35 USC § 102(a) Pacific Technica Corp. v. U.S., 11 CI.Ct. 393, affirmed in part and vacated in part 835 F.2d 871.

N.D.Ill. 1986. There can be no anticipation of invention unless all of the same elements are found in exactly same situation and united in same way to perform identical functions in a single prior art reference 35 U.S.C. § 102(a). Water Technologies Corp. v. Calco, Ltd., 658 f.Supp. 961, amendment denied 658 F.Supp. 980, affirmed in part, reversed in part 850 f.2d 660, certiorari denied 109 S.Ct. 498, 488 U.S. 968, 102 L.Ed.2d 534, on remand 714 F.Supp. 899, on remand 709 F.Supp. 821.

ARGUMENT REGARDING ISSUE 2

Whether claims 1-4 are unpatentable under 35 U.S.C. § 102(b) or in the alternative 35 U.S.C. § 103(a) over "Holcomb".

14.) Claims 1-4 were rejected under 35 U.S.C. § 102(b) as being anticipated by or, in the alternative, 35 U.S.C. § 103(a) as obvious over Holcomb. Again we have an unfounded statement at the heart of the examiners' rejection. Page 3, item 4, of the final office action states: "It is taught that conventional pipes of this type are capable of ranging in diameters from 6 inches to 21 feet in diameter and it is implied that the pipe in Holcomb can also be made up to those dimensions if such were needed, where the dimensions are not considered limited by the examples tested in Holcomb."

The reference of Holcomb is only six pages long including drawings, it is a short read. It can be read through several times easily. It does not contain any mention of testing, examples tested, sizes studied, etc. Again we have the unfounded "conventional pipes of this type" phrase, and most importantly "it is implied that the pipe in Holcomb can be made up to those dimensions if such were needed". Where is it "implied"? Again, can a statement that is not supported within the reference be used to identify an anticipation? Can the examiner hold the position "if such were needed" and still prove the motivation required to support a case for obviousness?

15.) The examiners, *"Response to Arguments"* on page 4 item 6 of the final office action is replete with distortions and unfounded statements. The examiner asserts, "The argument that Holcomb teaches only making the pipe in certain ranges is not considered persuasive", then provides a broad, groundless statement, backed up with Holcomb's alleged testing of pipes. On page 6 of the final office action the examiner finishes his response to arguments by returning to the Holcomb reference and continues his assertion that tables A and B refer to ranges tested. Both arguments of hindsight reasoning and the fact that Holcomb actually teaches away from the suggested combination are apparently being contested, but no supporting information is provided. Again, there is no mention of "ranges tested, sizes tested, studied, etc" in the Holcomb reference.

16.) Holcomb actually teaches of producing a pipe product that deviates from the standards set forth in the Handbook of Steel Drainage. The Holcomb patent column 2 lines 29-56 discusses that the pipes as specified in The Handbook of Steel Drainage are much stronger than needed for

many applications, concluding "the engineer is forced to specify an unnecessarily expensive product." The Holcomb invention is to produce the 2 2/3 x ½ in. and 3 x 1 in. corrugation profile pipe product with a space between each corrugation (see Holcomb patent FIG. 2A and FIG. 3), please recall that page 40 of The Handbook of Steel Drainage identifies these corrugations as being for Larger sizes (with diameters to 120 in.). This reference can not be utilized as an anticipation.

17.) The Holcomb reference does not disclose each and every element of the claimed invention. It is therefore apparent that the examiner's anticipation rejections raise the question of inherency with respect to the reference structures. Inherency may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient. The examiner must provide some evidence or scientific reasoning to establish the reasonableness of the examiner's belief that the functional limitation is an inherent characteristic of the prior art. In re Oelrich, 666 F.2d 578, 581, 212 USPQ 323, 326 (CCPA 1981) and In re Swinehart, 439 F.2d 210, 213, 169 USPQ 226, 229 (CCPA 1971). The examiner has provided no such evidence or reasoning with regard to this reference. It is also apparent from a thorough review of the reference that any such evidence or reasoning the examiner might put forth, will of necessity be somehow contorted, or abstract. With this in mind, these arguments, if any, should be considered in light of the following: A reference so obscure in its terminology that two conflicting theories as to its meaning may be deduced therefrom and supported by equally plausible arguments is too indefinite to be utilized as an anticipation. (see Cimiotti Unhairing Co. et. al v. Comstock Unhairing Co. et. al., 115 Fed. Rep. 524.)

18.) There is nothing in this reference that would enable one skilled in the art to produce spiral pipe at the jobsite. Furthermore, absent the ability to produce the pipe at the jobsite, there is nothing in the reference that would enable one skilled in the art to convey such a large pipe to location, or for that matter to explain the necessary modifications required for the factory machinery to produce larger sizes of pipe, i.e., tooling, pipe support modifications, etc. There is nothing in the reference that would enable one skilled in the art to produce a spirally formed pipe of any size.

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The examiner must go beyond merely presenting a theory, to support inherency. It must be demonstrated that one of ordinary skill in the art would be enabled to make the claimed invention.

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Cl.Ct. 1986. Anticipation or lack of novelty under patent law is established only when single prior art reference expressly describes or inherently contains each element of claimed invention, functioning in substantially the same way to produce substantially the same result. 35 U.S.C. § 102(a). Pacific Technica Corp. v. U.S., 11 Cl.Ct. 393, affirmed in part and vacated in part 835 F.2d 871.

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denied 109 S.Ct. 498, 488 U.S. 968, 102 L.Ed.2d 534, on remand 714 F.Supp. 899, on remand 709 F.Supp. 821.

19.) Let us now turn the focus to the examiner's rejections under 35 U.S.C. § 103. Spirally Formed Pipe that is larger in diameter than has been produced in the past is admittedly somewhat simplistic, particularly for those engaged in high tech industries, but that does not alter the fact the it is an invention.

"The apparent simplicity of a new device often leads an inexperienced person to think that it would have occurred to anyone familiar with the subject; * * *." Potts and Co. v. Creager et al.,70 O.G. 494; C.D. 1895, 143; U.S.

What is patentable? According to the MPEP Section 2100 Congress intended statutory subject matter to include "any thing under the sun that is made by man".

Invention is dependent upon the three essential characteristics of novelty, utility, and non-obviousness, which are codified in 35 U.S.C. § 101-103. Large Diameter Spirally Formed Pipe is patentable. It is novel, it has utility, and it is not obvious. Even a minor change may produce a patentable invention, where the result could not have been readily predicted beforehand by one skilled in the art. An invention will not be denied a patent because it embodies a solution which seems simple and obvious with the benefit of hindsight. SAF-GARD Products, Inc v. SERVICE PARTS, Inc. 532 F.2d 1266 (1976).

It is incumbent upon the examiner to provide a reason why one of ordinary skill in the art would have been led to modify a prior art reference or to combine reference teachings to arrive at the claimed invention. See *Ex parte Clapp*, 227 USPQ 972, 973 (BPAI 1985). To this end, the requisite motivation must stem from some teaching, suggestion or inference in the prior art as a whole or from the knowledge generally available to one of ordinary skill in the art and not from the appellant's disclosure. See, for example *Uniroyal, Inc. v. Rudkin-Wiley Corp.*, 837 F. 2d 1044, 1052, 5 USPQ2d 1434, 1052 (Fed. Cir.) cert. denied, 488 U.S. 825 (1988).

According to the Manual of Patent Examiners Procedures, "The initial burden is on the examiner to provide some suggestion of the desirability of doing what the inventor has done." The examiner has stated "Holcomb can also be made up to those dimensions if such were needed" (page 3 of the final office action). This would imply that the examiner does not see any desirability in doing what the inventor has done. There is no teaching, suggestion or inference in the prior art to support a rejection under 35 U.S.C. § 103.

20.) Continuing with rejections under 35 U.S.C. § 103, the examiner must not only provide some suggestion of the desirability of doing what the inventor has done, but must also present that there would be a reasonable expectation of success. See MPEP -- SECTION-- 706.02 "the teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art and not based on the applicant's disclosure". In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). The appellant has presented a number of arguments and

supporting documentation to show that in the absence of new machinery capable of producing the Large Diameter Spirally Formed Pipe at the job site, shipping the article as claimed to the job site is not possible. The basic problem is, that, if one produces a forty foot diameter pipe at their factory, it must stay at their factory. Any argument supporting a reasonable expectation of success should certainly provide some suggestion, or evidence to illustrate how success can be achieved without solving this problem. Additionally, the appellant notes that the factory machinery would require modifications not taught in the prior art to produce pipes as claimed.

The examiner has not provided any evidence of a suggestion, teaching, or motivation to modify the reference. The range of sources available, does not diminish the actual requirement for actual evidence. That is, the showing must be clear and particular. See e.g., C. R. Bard, Inc. v. M3 Sys., Inc., 157 f.3d 1340, 1352, 48 USPQ2d 1225, 1232 (Fed. Cir. 1998)

A broad conclusory statement regarding the obviousness of modifying a reference, standing alone is not "evidence". E.g., McElmurry v. Arkansas Power & Light Co., 995 F.2d 1576, 1578, 27 USPQ2d 1129, 1131 (Fed. Cir. 1993).

"Mere denials and conclusory statements, however are not sufficient to establish a genuine issue of material fact."; In re Sichert 566 F.2d 1154, 1164, 196 USPQ 209, 217 (CCPA 1977). Broad conclusory statements are all the examiner has provided, and within these statements there are obvious mistakes of a factual nature. The decision of the examiner must be reversed; which action the appellant now respectfully requests.

ARGUMENT REGARDING ISSUE 3.

Whether claims 5-9 are unpatentable under 35 U.S.C. § 103(a) over "Holcomb" in view of "The Handbook of Steel Drainage and Construction Products".

21.) With regard to the examiners' rejection of claims 5-9, Holcomb in view of The Handbook of Steel Drainage. The examiner asserts that The Handbook of Steel Drainage, suggests arched pipe is somehow stronger than round pipe. This teaching is not found in The Handbook of Steel Drainage. Again, we have a baseless, groundless, statement supporting the rejection.

The Federal Circuit states that "(the) mere fact that the prior art may be modified in the manner suggested by the examiner does not make the modification obvious unless the prior art suggested the desirability of the modification". In re Fitch, 972 F.2d 1260, 1266 n.4, 23 USPQ2d 1780, 1783-84 n.4 (Fed. Cir. 1992), citing In re Gordon, 773 F.2d 900, 902, 221 USPQ 1125, 1127 (Fed. Cir. 1984). The examiner's rejection states, that "Holcomb discloses all of the recited structure with the exception of reshaping the tube as an arch". **This has not been established.** In as much as this rejection is dependent upon the earlier rejection of claims 1-4, it is again inescapable that the examiner stated "Holcomb can also be made up to those dimensions if such were needed". How can the examiner show motivation in the face of such a blatant rejection of the inventions value? Again, there is no teaching, suggestion or inference in the prior art to support a rejection under 35 U.S.C. § 103.

22.) As stated earlier for rejections under 35 U.S.C. § 103, the examiner must not only provide *some suggestion of the desirability of doing what the inventor has done, but must also present that* there would be a reasonable expectation of success. See MPEP -- SECTION-- 706.02 "the teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art and not based on the applicant's disclosure". In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). The appellant has presented a number of arguments and supporting documentation to show that in the absence of new machinery capable of producing the Large Diameter Spirally Formed Pipe at the job site, shipping the article as claimed to the job site is not possible. The basic problem is, that, if one produces a forty foot diameter pipe at their factory, it must stay at their factory. Any argument supporting a reasonable expectation of success should certainly provide some suggestion, or evidence to illustrate how success can be achieved without solving this problem. Additionally, the appellant notes that the factory machinery would require modifications not taught in the prior art to produce pipes as claimed, and the Arching Equipment to arch pipes as claimed did not exist. The examiner has not provided any evidence of a suggestion, teaching, or motivation to modify any of the references or combination of references. The range of sources available, does not diminish the actual requirement for actual evidence. That is, the showing must be clear and particular. See e.g., C. R. Bard, Inc. v. M3 Sys., Inc., 157 f.3d 1340, 1352, 48 USPQ2d 1225, 1232 (Fed. Cir. 1998) A broad conclusory statement regarding the obviousness of modifying a reference, standing alone is not "evidence". E.g., McElmurry v. Arkansas Power & Light Co., 995 F.2d 1576, 1578, 27 USPQ2d 1129, 1131 (Fed. Cir. 1993).

"Mere denials and conclusory statements, however are not sufficient to establish a genuine issue of material fact."; In re Sichert 566 F.2d 1154, 1164, 196 USPQ 209, 217 (CCPA 1977).

Broad conclusory statements are all the examiner has provided, and within these statements there are obvious mistakes of a factual nature. The decision of the examiner must be reversed; which action the appellant now respectfully requests.

CONCLUSION

As an applicant pro se, it is extremely disturbing to be in the position of appealing to the Board of Patent Appeals and Interferences. This is my third patent, covering inventions related to Spirally Formed Pipe and it's Manufacture. The patent process itself has been a wonderful experience. It is a great challenge to file patents and respond to office actions. Considerable time, effort, financial obligation and stress are all factors an individual must face when seeking to obtain patent protection, and this is acceptable, when the process is *fair*.

The repeated rejections of the final office action, were soundly argued against in my response to the prior office action. These rejections contain obvious mistakes of a factual nature. It was possible that the examiner misunderstood the references the first time, but to restate the same rejections with the same choice of words, is to knowingly distort the teachings of the references. It's personally insulting, but more importantly it's *unfair*.

According to the MPEP- Section- 707.07(f) the examiner should answer "All Material Traversed" At best the examiners' response addressed six (6) arguments, while over twenty (20) were actually presented. The examiner did not identify the arguments being addressed, and did not provide the basis for the examiners' positions. In short, the examiners' final office action was completely unacceptable. No factual basis has been provided to support the examiners' rejections. The decision of the examiner must be reversed; which action the appellant now respectfully requests.

The examiner's first office action of May 8, 2000, contained claim rejections under 35 U.S.C. § 112, which were in error. The examiner contended that "A broad range or limitation together with a narrow range or limitation that falls within the broad range or limitation (in the same claim) is considered indefinite, since the resulting claim does not clearly set forth the metes and bounds of the patent protection desired." The claims in question actually include "whereby" statements, which are in some ways clarifying. Claim 1 as originally presented is as follows:

1. A spirally formed pipe, comprising an elongated strip of ductile material formed into joined, adjacent helical convolutions, having a diameter larger than 15 feet, whereby said pipe is larger than similar pipe produced in the past.

The "whereby" statement is not necessary for the claim to provide the patent protection desired. It does however, help to clarify that this is not just "a change in diameter", but a change in the range of sizes that have been available up till now.

The appellant would prefer to see the claims restored to their original condition.

As a final note; Just one argument, if justified, should be enough to prevail with an examiner. My experience, however limited in this area causes me to conclude that arguments are not easy to come up with, unless they are in fact warranted. In the case of this Large Diameter Spirally Formed Pipe application, there have been numerous arguments presented. All of the arguments are still valid. The examiners response did not address the substance of these arguments. Please refer to Amendment B for the actual arguments presented.

As an Applicant Pro Se and now as the Appellant, I am very concerned that I receive this patent on Large Diameter Spirally Formed Pipe. Please accept this appeal, and Reverse the Examiner.

Very respectfully,

Scott E. Johnston
Applicant Pro Se/Appellant

16857 Hummingbird Lane, Cottonwood, CA 96022 Telephone & Fax (530) 527-4000

Certificate of Mailing: I certify that on the date below this document and referenced attachments, if any, will be deposited with the U.S. Postal Service as first class mail in an envelope addressed to: "ASSISTANT COMMISSIONER FOR PATENTS, WASHINGTON, DC 20231."

October 6, 2001 _____
Scott E. Johnston, Applicant/Appellant

APPENDIX A

Claims: I claim:

1. A spirally formed pipe, comprising an elongated strip of ductile material formed into joined, adjacent helical convolutions, having a diameter larger than 15 feet.

2. The pipe according to claim 1 further comprising that said convolutions form the wall of said pipe, and that said wall may be smooth, corrugated, or profiled.

3. The combination of claim 2 further including that said wall may be smooth, corrugated, or profiled with increased dimensional proportions as pipe size is increased.

4. The pipe according to claim 1 further comprising that said joined adjacent helical convolutions includes welded and or lock seam joining of said ductile material.

5. A spirally formed pipe, comprising an elongated strip of ductile material formed into joined, adjacent helical convolutions, reshaped into an arch shape, having a beginning diameter above 144 inches.

6. The pipe according to claim 5 further comprising that said convolutions form the wall of said pipe, and that said wall may be smooth, corrugated, or profiled.

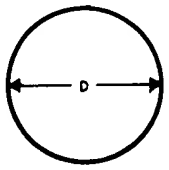
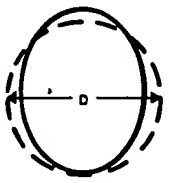
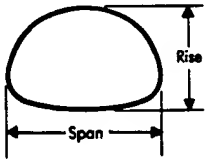
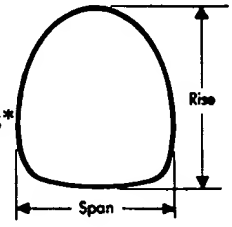
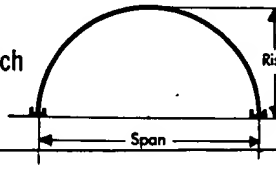
7. The combination of claim 6 further including that said wall may be smooth, corrugated, or profiled with increased dimensional proportions as pipe size is increased.

8. The pipe according to claim 5 further comprising that said joined adjacent helical convolutions includes welded and or lock seam joining of said ductile material.

9. A spirally formed pipe larger than 144 inches in diameter before reshaping into an arch shape.

APPENDIX B

Table 1-1 Shapes and Uses of Corrugated Conduits

Shape	Range of Sizes	Common Uses
Round 	6 in. to 21 ft	Culverts, subdrains, sewers, service tunnels, etc. All plates same radius. For medium and high fills (or trenches).
Vertically-elongated (ellipse) 5% is common 	4 ft to 21 ft nominal; before elongating	Culverts, sewers, service tunnels, recovery tunnels. Plates of varying radii; shop fabrication. For appearance and where backfill compaction is only moderate.
Pipe-arch 	span x rise 18 in. x 11 in. to 20 ft 7 in. x 13 ft 2 in.	Where headroom is limited. Has hydraulic advantages at low flows. Corner plate radius, 18 inches or 31 inches for structural plate.
Underpass* 	span x rise 5 ft 8 in. x 5 ft 9 in. to 20 ft 4 in. x 17 ft 10 in.	For pedestrians, livestock or vehicles (structural plate).
Arch 	span x rise 6 ft x 1 ft 9½ in. to 25 ft x 12 ft 6 in.	For low clearance large waterway opening, and aesthetics (structural plate).
Specials	Various	For lining old structures or other special purposes. Special fabrication.

*For equal area or clearance, the round shape is generally more economical and simpler to assemble.

CHAPTER 1 Product Details and Fabrication

Section A—CONDUITS: Pipe, Pipe-Arches, Arches

BACKGROUND OF CORRUGATED STEEL CONDUITS

Corrugating a flat sheet has long been known to increase its stiffness and strength. Fig. 1-1. Corrugated steel sheets have been produced almost since the first rolling mill was built in England in 1784. But it was not until after 1890, when mass-produced steel sheets became abundant, that their use grew rapidly.

Corrugated metal pipe was first developed and used for culverts in 1896. As experience was gained in the use of this thin-wall, lightweight, *shop-fabricated* pipe, the diameters gradually increased to 96 in. and larger. Fill heights became greater, even exceeding 100 ft. A further development, in 1931, was structural plate pipe with larger corrugations, for *field assembly*. Diameters and arch spans beyond 25 ft. have been successfully installed.

SHAPES OF CONDUITS

The designer has a wide choice of standard cross-sectional shapes of corrugated steel and structural plate conduits as shown in Table 1-1. Size and service use may control the shape selected, with strength and economy as additional factors. For sectional properties of corrugated steel sheets and plates, see Tables 1-5 through 1-9. For sizes, weights and other details, use Tables 1-10 through 1-24.

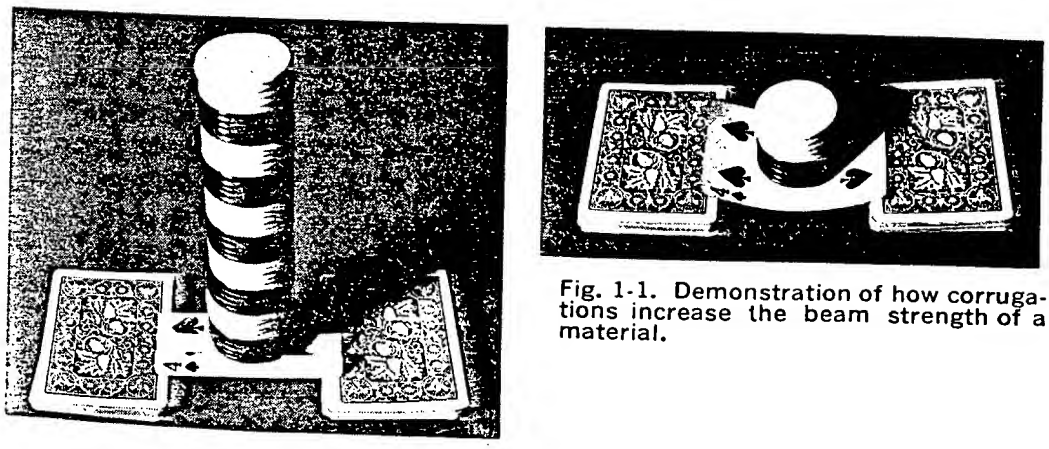


Fig. 1-1. Demonstration of how corrugations increase the beam strength of a material.

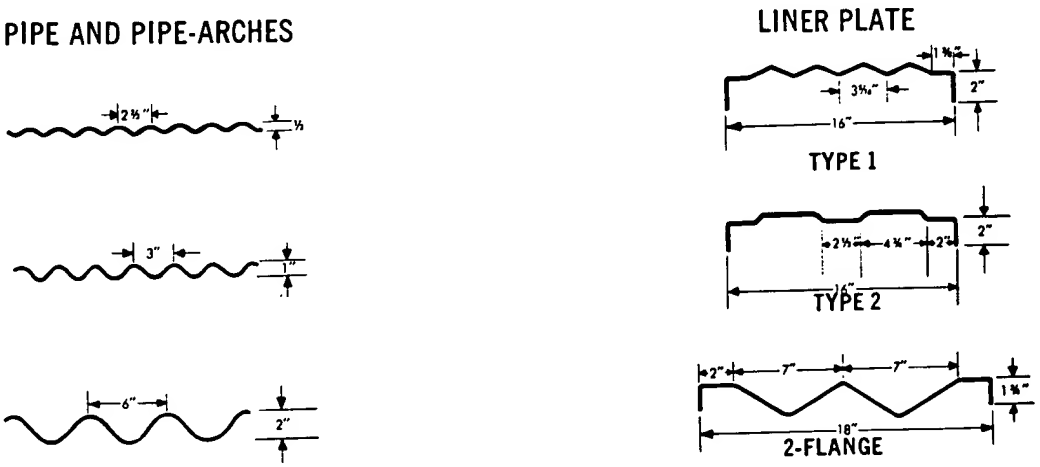


Fig. 1-2. Corrugation types commonly used for galvanized sheet and structural steel conduits and tunnel liner plate.

DESCRIPTION OF CORRUGATIONS

There are many kinds of corrugations, some of which are shown in Fig. 1-2. Corrugations commonly used for pipes or conduits are termed "circular arcs connected by tangents," and are described by pitch, depth and inside forming radius. Pitch is measured at right angles to the corrugations from crest to crest.

For riveted or resistance spot-welded pipe with circumferential (annular) seams, the corrugations are of 2⅔ in. pitch by ½ in. depth and 3-in. by 1-in.

For lock seam pipe, the seams and corrugations run helically (or spirally) around the pipe. For small diameters of subdrainage pipe (6, 8, 10 in., etc.) the pitch vs. depth dimension is 1½ x ¼ in. Larger sizes (with diameters to 120 in.) use 2 x ½ in., 2⅔ x ½ in. and 3 x 1 in. corrugations.

Structural plate pipe is a bolted structure. The 6 x 2 in. corrugation is the standard of the American Association of State Highway Officials.[13]

SECTIONAL PROPERTIES

Sectional properties of the arc-and-tangent type of corrugation are derived mathematically.[1] These include area, A, moment of inertia, I, section modulus, S, and radius of gyration, r. Research by American Iron and Steel Institute[2] has shown that failure loads in bending and deflection within the elastic range can be closely predicted by using computed sectional properties of the corrugated sheet. See Tables 1-5 through 1-9.[3,4]

(*Text continued, page 46*)

Table 1–2 Conversion of Nominal Gage to Thickness

Gage No.	22	20	18	16	14	12
Uncoated Thickness—In.	0.0299	0.0359	.0478	.0598	.0747	.1046
Galvanized Thickness*—In.	0.034	0.040	.052	.064	.079	.109
Galvanized Thickness—mm.	0.762	1.02	1.32	1.63	2.01	2.77

Gage No.	10	8	7	5	3	1
Uncoated Thickness—In.	.1345	.1644	.1838	.2145	.2451	.2758
Galvanized Thickness*—In.	.138	.168	.188	.218	.249	.280
Galvanized Thickness—mm.	3.51	4.27	4.78	5.54	6.32	7.11

*Also referred to as "specified thickness" for corrugated steel pipe products.
For tunnel liner plates, guardrail and other products, see chapters on those products.

APPENDIX C

United States Patent [19]

Holcomb

[11] **Patent Number: 4,852,616**

[45] **Date of Patent: Aug. 1, 1989**

[54] **CORRUGATED PIPE**

[75] Inventor: **Richard A. Holcomb**, East Point, Ga.

[73] Assignee: **Mid-State Drainage Products, Inc.**, Stockbridge, Ga.

[21] Appl. No.: **29,390**

[22] Filed: **Mar. 23, 1987**

Related U.S. Application Data

[63] Continuation of Ser. No. 818,429, Jan. 10, 1986.

[51] **Int. Cl.**[4] **F16L 9/02**

[52] **U.S. Cl.** **138/173**; 138/121; 138/122; 138/135; 138/154

[58] **Field of Search** 138/173, 121, 122, 154, 138/129, 134, 135; 228/17.7, 145

[56] **References Cited**

U.S. PATENT DOCUMENTS

T103,901	2/1984	Lapke et al. .	
365,630	6/1887	Pratt .	
1,057,505	4/1913	Smith	138/173
1,259,233	3/1918	Hartman .	
1,263,340	4/1918	Silk .	
1,270,579	6/1918	Witzenmann	138/122
2,852,597	9/1958	Raydt et al.	138/122
2,934,466	4/1960	Molla	138/173
3,094,147	4/1961	Nemer .	
3,224,814	12/1965	Fisher	138/122
3,263,321	8/1966	Lombardi	228/17.7
3,731,711	5/1973	Bauer	138/173
3,913,623	10/1975	Siegwart	138/122
4,562,733	1/1986	Kant	138/122

FOREIGN PATENT DOCUMENTS

217131	7/1959	Austria	138/122
522825	10/1953	Belgium	138/122
237250	1/1909	Fed. Rep. of Germany	138/122
2156579	5/1973	Fed. Rep. of Germany	138/122
4806	of 1891	United Kingdom	138/173
2285	of 1899	United Kingdom	138/173
0024984	of 1900	United Kingdom	138/173
6093	of 1901	United Kingdom	138/173
2610	of 1904	United Kingdom	138/173
409991	9/1933	United Kingdom	138/122

OTHER PUBLICATIONS

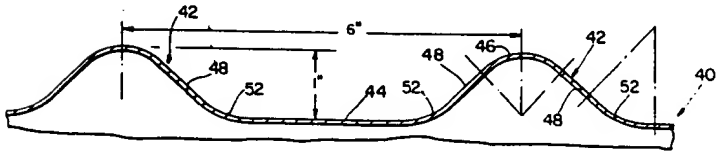
Handbook of Steel Drainage & Highway Construction Products, Published by American Iron and Steel Institute, 1983.

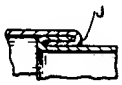
Primary Examiner—James E. Bryant, III
Attorney, Agent, or Firm—Irvin A. Lavine

[57] **ABSTRACT**

A spirally wound corrugated pipe of sheet steel or the like is provided with outwardly convex corrugations which are spaced apart, with a flat portion of single wall thickness between adjacent corrugations. In one embodiment, the corrugation have a pitch of five inches and a height of one-half inch; in another embodiment, the pitch is six inches and the height is one inch.

12 Claims, 1 Drawing Sheet





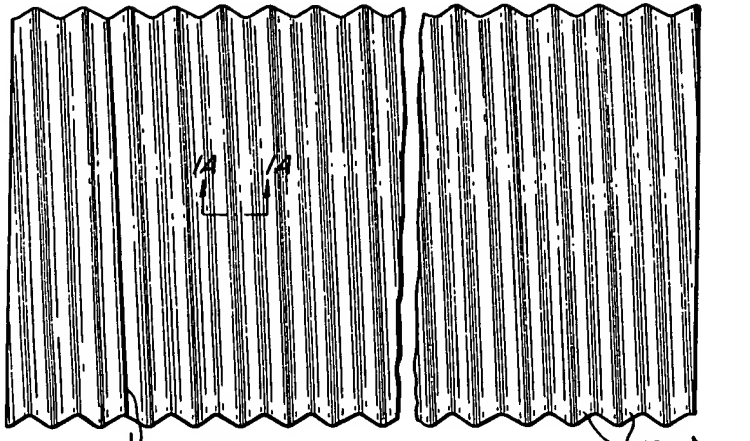


FIG. 1
PRIOR ART

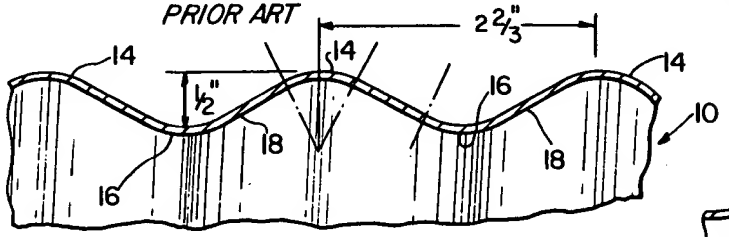


FIG. 1A
PRIOR ART

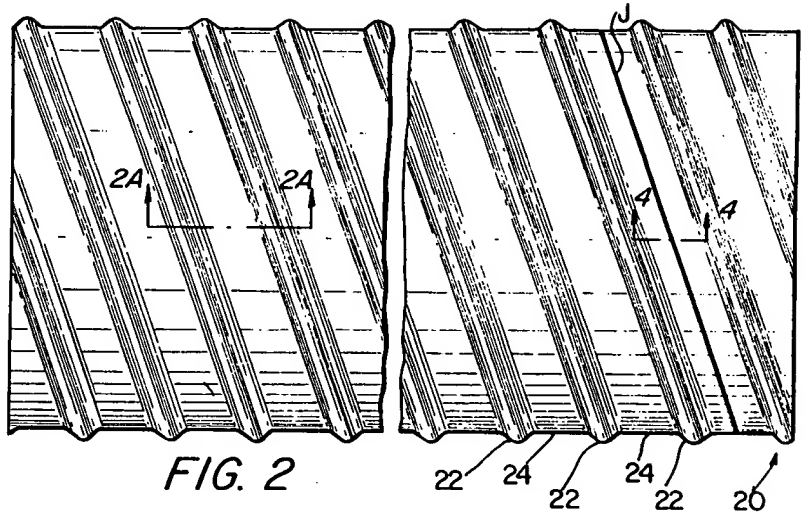


FIG. 2

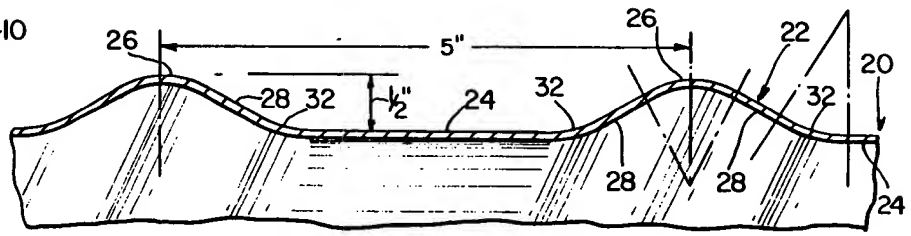


FIG. 2A

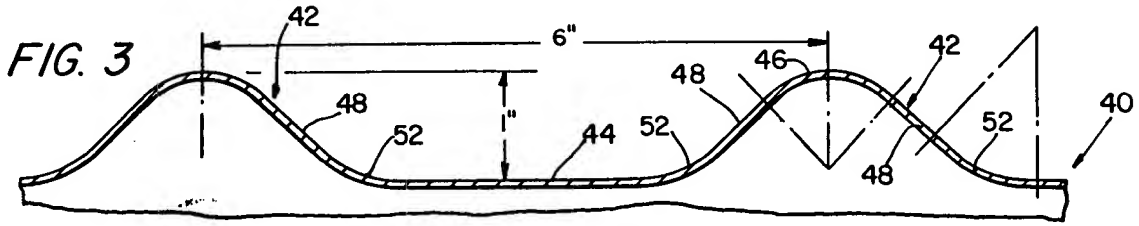


FIG. 3

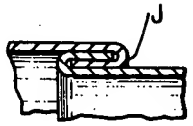


FIG. 4

CORRUGATED PIPE

This application is a continuation, of application Ser. No. 818,429, filed Jan. 10, 1986, now abandoned.

BACKGROUND OF THE INVENTION

The present invention relates to a pipe of sheet steel or the like, fabricated of a single strip of metal, and which is provided with spirally extending corrugations.

It has long been recognized that pipes such as are used for conduits, drainage and the like are subject to substantial compressive loads, and that they have greater strength if they are corrugated, instead of being of purely cylindrical construction. For example, Pratt et al. U.S. Pat. No. 365,630 discloses the provision of a tube of a suitable metal which is corrugated spirally with a single rib and which extends from one end of the tube to the other. The tube is produced by placing a plain tube upon a spirally corrugated mandrel, which is placed between the centers of a lathe, and a roll of angular corrugations is then forced into the tube, so as to cause it to take the form of the corrugated mandrel. This corrugated tubing had an exterior sinusoidal profile formed by convex portions connected directly to concave portions. Such tubing is disclosed as being used in connection with boilers, radiators, and the like.

Silk U.S. Pat. No. 1,263,340 discloses a spiral sheet metal pipe which is intended to be used for culverts, sewers, and the like, being formed with continuous spirally extending corrugations, with an upstanding spiral seam provided by flanges extending outwardly from the pipe. The disclosed pipe is formed of a single strip of sheet metal which is wound or coiled into spiral form, and having the lateral edges interlocked by the above noted outstanding flange and seam construction. It has a sinusoidal profile.

Hartman U.S. Pat. No. 1,259,233 provides a drain pipe of sheet metal, for roadways, gutters, and the like, made of a strip having circular corrugations, and which is formed into a circle and welded in the circular form, with plural strips being axially joined. The disclosed pipe has a sinusoidal profile.

Nemer U.S. Pat. No. 3,094,147 provides helically wound strip material formed into bendable tubing, useful, for example, as part of an automobile exhaust system. The edges of the strip of which the tubing is formed with rolled edges which are joined into a four-thickness locked seam. The profile is sinusoidal, interspersed with flat portions formed at the four-thickness seams.

Lupke et al. Defensive Publication T103,901 discloses a stiff thin walled plastic pipe of thermoplastic material, the longitudinal cross section profile of the wall comprising a wave form.

Spirally wound steel pipe is widely used for culverts, storm sewers, subdrains, spillways, underpasses and service tunnels. According to Handbook of Steel Drainage and Highway Construction Products, published by American Iron and Steel Institute (Second Edition, 1971), round or circular corrugated steel conduits are in common use for such purposes for medium and high fills, or trenches, and range in diameter from six inches to 21 feet. The corrugations are stated to be "circular arcs connected by tangents" and are described by pitch, depth and inside forming radius. Riveted and resistance spot-welded pipe are noted, having circumferential seams, with the corrugations being of two and two-thirds inch pitch by one and one-half inch depth and three inch pitch by one inch depth. There is also noted lock seam pipes, with the seams and corrugations running helically (or spirally) around the pipe. Small diameters of six, eight, ten inches, etc., have a pitch of one and one-half inches by one-quarter inch depth, while larger sizes, with diameters up to twelve feet, have a two inch pitch by one-half inch depth, two and two-thirds inch pitch by one and one-half inch depth and three inch pitch by one inch depth. Tables are provided for the configurations of the various pipes, with the pipes being of convex and concave circular arcs connected by inclined flat tangential portions. This publication provides tables setting forth the maximum cover of fill material for corrugated steel pipe, taking into account pipe diameter and thickness of the sheet steel material of which the corrugated pipe is made. For example, Table HC-1 provides that with a corrugated pipe having a two and two-thirds inch pitch and one-half inch depth corrugations, for an H 20 Live Load, where the pipe diameter is eighteen inches, and the pipe wall thickness is 0.052 inches, the maximum cover is 132 feet. With other factors being the same, and the thickness increased to 0.079 inches, the maximum cover is 207 feet. With the use of these tables, engineers designing culverts, drain pipes, etc., are able to determine the required size of pipe, based upon such variable factors as the type of load, depth of fill, and type of soil.

As indicated by the above noted Handbook, the corrugated steel pipe which has been produced has been engineered for the maximum fill which pipe of a particular configuration is capable of safely supporting. To this end, the thickness and the shapes of the corrugations have been standardized, the corrugations having, as above noted, circular arcs connected by tangents which were inclined. Such pipes have been sufficiently strong to sustain the design loads as set forth in the above noted Handbook.

Consequently, an engineer, under present practices, has a limited number of available pipe sizes and dimensions. For example, where the engineer is to specify a corrugated steel pipe for an H 20 Live Load, the pipe having an eighteen inch diameter, such pipe is available in thicknesses of 0.052 inches, 0.064 inches, and 0.079 inches, which are specified for maximum cover in feet of 132 feet, 166 feet and 207 feet, respectively. If the engineer is faced with a project which requires such an eighteen inch diameter corrugated steel pipe, with a rated H 20 Live Load, and he is aware that his maximum cover will be, for example, 30 feet, then he is faced with specifying a pipe having a capability of withstanding more than four times the actual cover of that project. Nevertheless, there is available only a very substantial over-strength pipe for the particular requirement, and therefore the engineer is forced to specify an unnecessarily expensive product.

While the above noted publication refers to lock seam pipe, with helical corrugations, and to resistance spot-welded pipe with circumferential seams, there has recently been introduced equipment for producing spiral wound butt-welded pipes. This equipment is manufactured by Armco Steel Company. By avoiding the rolled edges which produce a lock seam, and utilizing the butt-welded seam, a reduction of metal cost of approximately five percent is achieved. The equipment required to produce the butt-welded seam of the corrugated helical steel pipe is expensive, and therefore, although there is a saving in direct metal cost, there is a

substantial addition in overall cost due to the noted welding equipment.

SUMMARY OF THE INVENTION

A corrugated spiral pipe of strong material, such as steel sheet, has spaced, spirally extending corrugations. Between the corrugations are flat portions, which are closer to the axis of the pipe than are the crests of the corrugations. Each corrugation comprises a circular arc, and an inclined tangential portion, the tangential portions each being connected by a concave circular arc with a flat portion which lies closer to the axis of the pipe than the crests of the corrugations.

In preferred embodiments, the pitch between corrugations may be five inches, with a depth of one-half inch. In an alternate embodiment, the pitch may be six inches, with a depth of one inch.

Preferably, the edges of the strip which is corrugated to form the corrugated pipe of the present invention are folded over, so as to provide a lock seam. However, if desired the edges may be secured by other techniques, including butt-welding.

Among the objects of the present invention is the provision of corrugated pipe which will utilize less material than is required for the production of known pipes of the same thickness, diameter and length; another object of the present invention being the provision of corrugated steel pipe which can be fabricated at a significantly lower cost than the pipe now made, and which is of comparable thickness, diameter and size.

Other objects and many of the attendant advantages of the present invention will be readily understood from a consideration of the following specifications, claims and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view, with parts broken away, of a conventional corrugated steel pipe.

FIG. 1A is an enlarged cross-sectional view taken on the line 1A—1A of FIG. 1.

FIG. 2 is an elevational view, with parts broken away, of a corrugated pipe in accordance with the present invention.

FIG. 2A is a cross-sectional view taken on the line 2A—2A of FIG. 2.

FIG. 3 is a cross-sectional view similar to FIG. 2A, and showing an alternate embodiment of a corrugated pipe in accordance with the present invention.

FIG. 4 is a cross-sectional view taken on the line 4—4 of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, wherein like or corresponding reference numerals are used for like or corresponding parts throughout the several views, there is shown in FIG. 1A a prior art corrugated pipe designated 10, and being provided with helically extending corrugations 12. In practice, a single sheet of steel of the desired width and thickness is subjected to a plurality of corrugating rollers, which provide a plurality of corrugations across the width of the steel sheet, and then the corrugated steel strip is helically formed, with provision for joining of the edges at helical joints J so as to form a continuous pipe. As above noted, the joining of the edges may be either by rolling the edges, so as to provide the structure for the formation of a lock seam, or the edges may be butt-welded. The length of pipe 10 which is produced is limited only by the length of the original steel strip stock material, the handling facilities of the production plant, and transportation equipment. In practice, a saw is provided to saw the completed pipe into suitable lengths for handling and transportation.

FIG. 1A shows the shape of the wall of the corrugated pipe 10. This illustrates the standard shape of the corrugations, known as "circular arcs connected by tangents". Here, there are convex circular arcs 14, the arcs 14 being arranged in a spaced series. There are also provided concave circular arcs 16 intermediate the convex circular arcs 14. Intermediate adjacent circular arcs 14 and 16 there are inclined flat tangent portions 18, these being tangent to both the convex circular arcs 14 and concave circular arcs 16.

The depth of the corrugations of the typical prior art corrugated spiral pipe 10 is measured from the bottom of the concave circular arc 16 to the top of the convex circular arc 14, and is one-half inch in the pipe 10. The pitch of the corrugations of the pipe 10 is two and two-thirds inches, as measured at right angles to the corrugations from crest to crest.

Referring now to FIG. 2, there is shown a helically wound corrugated pipe 20 in accordance with the present invention. Pipe 20 is produced by equipment similar to that described in connection with the production of pipe 10 of FIG. 1A, except that the rolls or dies include not only dies for forming corrugations, but dies for maintaining portions of the stock steel strip in flat condition. Thus, there will be seen helical corrugations 22, and between them there are flat portions 24. Helical joints J join the edges of adjacent strips to form the pipe 20. It will be noted, further, that while the thickness of the sheet steel of the pipe 20 in accordance with the present invention may be of standard thicknesses as used in the art to produce conventional pipe 10, and while the diameters of pipes 20 may be the same as the diameters of conventional pipe 10, the angle of the corrugations 22 relative to a plane normal to the axis of the pipe 20 may be significantly different from i.e., greater than, as shown the angles of the corrugations 12. The angles of the corrugations for pipes 20 of various diameters are given as follows:

TABLE A

PIPE DIAMETER (Inches)	ANGLE (Degrees)
12	38
15	30
18	25
21	20
24	19
30	14
36	13
42	10
48	9
54	8
60	7

Referring now to FIG. 2A, the corrugation 22 of pipe 20, as viewed from the exterior thereof comprises a convex circular arc 26, on either side of which is an inclined flat tangent portion 28. Each corrugation 22 subtends an angle of less than 180° an angle of less than 90° being shown in FIG. 2A. Adjacent each of the inclined flat tangential portions 28 is a concave circular arc portion 32 which is tangent to both the inclined flat portion 28 and the horizontal flat portion 24. There is thereby provided a smooth transition of the sheet steel

from each horizontal flat portion 24 to the adjacent corrugations 22.

The horizontal flat portion 24 has substantial length, or distance between adjacent concave arc portions 32. The corrugation 22, concave arc portion 32 and horizontal flat portion 24 are located sequentially along the axis of pipe 20. The pitch of the pipe 20, as measured perpendicularly between crests of successive corrugations 22, is five inches, and the depth is one-half inch, as measured from the crest of a corrugation 22 to the flat portion 24.

A pipe 20 in accordance with the present invention may be made with a reduction in cost of sheet steel stock, and using standard lock seams, which is approximately six and one-half percent less than a pipe 10, based on equal thicknesses, diameters and lengths of the pipes. This results in an overall cost reduction of a pipe 20 of approximately fourteen percent, in comparison with the pipe 10 of the same wall thickness, length and diameter.

Referring now to FIG. 3, there is shown a pipe 40 in accordance with the present invention, comprising helical corrugations 42, having the same general characteristics as corrugations 22; that is, there is provided a convex circular arc portion 46, a pair of inclined flat portions 48 tangential thereto, a pair of concave circular arc portions 52, and flat portions 44 between arc portions 52. As shown, the corrugations 42 subtend an angle of approximately 90°. The pitch between corrugations 42 of the pipe 40 shown on FIG. 3 is six inches, and the depth of the corrugations, measured from the flat portion 44 to the crest of the corrugations 42 is one inch. As is apparent, the pipes 20 and 40 have in longitudinal cross-section repeated successions of flat portions and corrugations, the helically extending and longitudinally spaced corrugations 22 and 42 having flat portions 24 and 44 intermediate the corrugations 22 and 42. The flat portions 24 and 44 are parallel to the axis of the pipe 20, 40, respectively. As is apparent from FIGS. 2A and 3, the crest of the corrugations 22 and 42 are at a greater radius than are the flat portions 24 and 44, respectively.

The angle of the corrugations of the pipe 40, relative to a plane normal to the axis of pipe 30 are those set forth in the following table:

TABLE B

PIPE DIAMETER (Inches)	ANGLE (Degrees)
48	7
54	6
60	6
66	5
72	5
78	4
84	4
90	4
96	3
102	3
108	3

The pipes 20 and 40 are illustrative of pipes made in accordance with the present invention. The herein disclosed pipes are significantly less expensive than are standard pipes currently manufactured, as exemplified in the above noted Handbook of Steel Drainage & Highway Construction Products. The pipes in accordance with the present invention are entirely suitable for many installations, particularly where the anticipated fill height and load factors, which exert compressive loads on the pipe, are significantly less than the maximum for which the standard corrugated steel pipes are suitable.

The claims and the specification describe the invention herein presented and the terms that are employed in the claims draw their meaning from the use of such terms in the specification. Some terms employed in the prior art may be broader in meaning than specifically employed herein. Whenever there is a question between the broader definition of such terms as used in the prior art and the more specific use of the terms herein, the more specific meaning is meant.

It will be obvious to those skilled in the art that various changes may be made in the herein disclosed apparatus. However, the invention is not limited to what is set forth in the specification or described in the drawing, but only as defined in the claims attended hereto.

I claim:

1. In a pipe adapted to be used in the ground as a culvert, the improvement comprising:

(a) said pipe formed of a strip of material of uniform thickness which enables the pipe to withstand compressive loads experienced by culverts in the ground,

(b) means for helically joining together adjacent edges of said strip to form said pipe,

(c) the pipe being of single thickness of material between said helical joint means,

(d) the pipe having helically extending longitudinally spaced corrugations of equal diameters, and a flat portion between adjacent corrugations,

(e) said flat portions being cylindrical and of equal diameter,

(f) the material of said flat portions and said corrugations having substantially the same thickness,

(g) said corrugations each comprising as viewed from the exterior of the pipe, a convex portion having an arcuate crest in longitudinal cross-section at a greater radius from the pipe axis than said flat portion, said convex portion subtending an angle of less than 180°,

(h) means for providing a smooth transition of said material being each said flat portion and the adjacent corrugations comprising, as viewed from the exterior of the pipe, a concave portion at the edge of said flat portion and tangent thereto, said concave portions each joined to a said convex portion,

(i) said corrugations, said concave portions adjacent thereto, and said flat portions being located sequentially along the axis of the pipe, and

(j) said corrugations being the only protuberances of said pipe between said helical joint means.

2. In a pipe adapted to be used in the ground as a culvert, said pipe being of sheet material of uniform thickness and substantial strength which enables the pipe to withstand compressive loads experienced by culverts in the ground,

said pipe being cylindrical and of a helically wound strip of said sheet material having helical joints,

said pipe having helically extending longitudinally spaced corrugations, substantially all of which are of single wall thickness, said corrugations being of uniform diameter and each subtending an angle of less than 180°,

flat portions intermediate said corrugations and parallel to the axis of said pipe, substantially all of said flat portions being of single wall thickness and uniform diameter,

said corrugations each being convex as viewed from the exterior of the pipe and with an arcuate crest in longitudinal cross-section at a greater radius from the axis of the pipe than said flat portions,

spaced portions concave as viewed from the exterior of said pipe, each tangent to a said flat portion at one end, and

flat portions inclined relative to the pipe axis intermediate said convex corrugations and said concave portions and tangent thereto,

said corrugations, said concave portions adjacent thereto, and said flat portions being located sequentially along the axis of the pipe,

said pipe being of uniform thickness between joints, the thickness and material of said pipe enabling said pipe to withstand compressive loads experienced by culverts in the ground.

3. The pipe of claim 2, the corrugations having a pitch of approximately five inches and having a height above said intermediate flat portions of approximately one-half inch.

4. The pipe of claim 3, the angle of the corrugations and pipe diameter being as set forth in Table A hereof.

5. The pipe of claim 2, the corrugations having a pitch of approximately six inches and having a height above said intermediate flat portions of approximately one inch.

6. The pipe of claim 3, the angle of the corrugations and pipe diameter being as set forth in Table B hereof.

7. In a pipe to be used in the ground as a culvert, the improvement comprising:

said pipe being cylindrical, and formed of a strip of material of uniform thickness which enables the pipe to withstand compressive loads experienced by culverts in the ground,

the strip of material being helical and having joints at the edges of the strip, the pipe being of single thickness of material being the joints,

the pipe having helically extending longitudinally spaced corrugations of equal diameter, convex as viewed from the exterior of the pipe, said corrugations each being arcuate and subtending an angle of less than 180°,

intermediate flat portions of substantially equal diameter less than the diameter of said corrugations between said corrugations,

the material of said intermediate flat portions and said corrugations having substantially the same thickness,

means for providing a smooth transition between a said corrugation and adjacent intermediate flat portions comprising a pair of spaced portions, concave as viewed from the exterior of said pipe, each said concave portion being tangent to a said intermediate flat portion and joined to said convex corrugation,

said convex corrugations each having an arcuate crest at a greater radius from the axis of the pipe than said intermediate flat portions,

said corrugations being the only protuberances of said pipe between said joints,

said corrugations, said concave portions adjacent thereto, and said intermediate flat portions being located sequentially along the axis of the pipe.

8. The pipe of claim 7, said pipe further comprising flat portions inclined relative to the pipe axis and each tangent to a said concave portion and to said convex corrugation.

9. The pipe of claim 7, the corrugations having a pitch of approximately five inches and having a height above said intermediate flat portions of approximately one-half inch.

10. The pipe of claim 9, the angle of the corrugations and pipe diameter being as set forth in Table A hereof.

11. The pipe of claim 7, the corrugations having a pitch of approximately six inches and having a height above said intermediate flat portions of approximately one inch.

12. The pipe of claim 11, the angle of the corrugations and pipe diameter being as set forth in Table F hereof.

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